$$B = b_0 L, B = 3{,}62 \cdot 10^{-6} \cdot 500 = 1{,}810 \cdot 10^{-3} \text{ S.}$$

Knowing the power line capacitive susceptance, we shall find out charge capacity of the power line at rated voltage:.

$$Q_l = U^2 B, Q_l = 500000^2 \cdot 1{,}81 \cdot 10^{-3} = 4{,}525 \cdot 10^8 \text{ Var.}$$

In case of open transmission line (zero transmission capacity), power line charge capacity is equal to reactor charge capacity, i.e. $Q_l = Q_r$.

Now we shall deduce resistance from the reactor charge capacity formula: $Q_r = U^2 \frac{1}{x_r}$, from here. $x_r = \frac{U^2}{Q_r}$, $x_r = \frac{25 \cdot 10^{10}}{4{,}525 \cdot 10^8} = 552$ *ω.*

Now we shall determine cumulative inductance of two reactors, necessary for full compensation of the power line charge capacity:

$$L_r = \frac{x_r}{\omega} = \frac{x_r}{2\pi f} = \frac{552}{2 \cdot 3.14 \cdot 50} = 1{,}76 \text{ H.}$$

Conclusion

Therefore, installation of a capacitor bank and two shunt reactors with the calculated values will ensure full reactance compensation and power line conductivity, considerably reduce transmission losses, and prevent hazardous overvoltage.

References:

1. Neklepaev B.N, Kruchkov I.P. Electrical annex of power stations and substations: Reference materials for term and graduation projects . Moscow:Energoatomizdat, 1989. p.608.
2. URL: http://bourabai.kz/toe/ac_9.htm.

Tashirev, I.A.
AC/DC Transmission
National Research Tomsk Polytechnic University.

Abstract

Disputes between supporters of AC and DC take place since the time of Tesla and Edison. Which is better? In this paper we try to understand this poll. First, we consider the advantages and disadvantages of AC and DC. Next, consider the option of combined AC and DC. In conclusion, we can conclude which of the two options would be preferable.

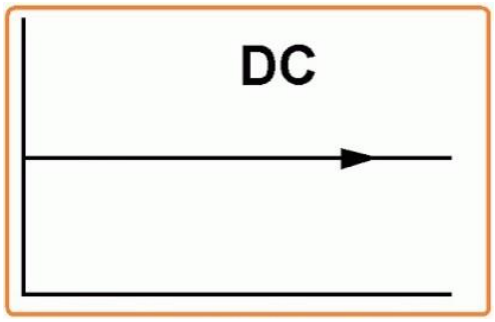
Introduction.

Consumption of electricity is an essential life process of modern society. Electricity is used everywhere, starting with the largest industrial facilities, ending appliances in our homes. Energy consumption is growing every year, increases the amount of power transmitted over power lines. This greatly affects the stability of the power system. Increasingly, there are questions about transmission of electric power. Nikola Tesla and Thomas Edison divided technical society into two parts, which are still in their irreconcilable views: direct current or alternating current. Which is better?.

Comparison between AC and DC transmission system (with their advantages and disadvantages)

Electric Power can be transmitted in both AC and DC. But there are some advantages and disadvantages of both systems. So it is important that we discuss technical advantages and disadvantages of both AC and DC Systems.

DC Transmission:

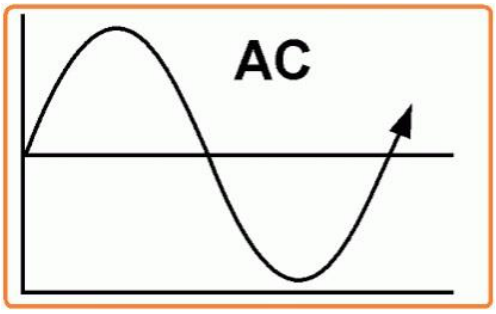


Advantages:

1. There are two conductors used in DC transmission while three conductors required in AC transmission.
2. There are no Inductance and Surges (High Voltage waves for very short time) in DC transmission.
3. Due to absence of inductance, there are very low voltage drops in DC transmission lines compared with AC (if both Load and sending end voltage is same).
4. There is no concept of Skin effect in DC transmission. Therefore, small cross sectional area conductor required.
5. A DC System has a less potential stress over AC system for same Voltage level. Therefore, a DC line requires less insulation.
6. In DC System, there is no interference with communication system.
7. In DC Line, Corona losses are very low.
8. In High Voltage DC Transmission lines, there are no Dielectric losses.
9. In DC Transmission system, there are no difficulties in synchronizing and stability problems.
10. DC system is more efficient than AC, therefore, the rate of price of Towers, Poles, Insulators, and conductor are low so the system is economical.
11. In DC System, the speed control range is greater than AC System.
12. There is low insulation required in DC system (about 70%).
13. The price of DC cables is low (Due to Low insulation).
14. In DC Supply System, the Sheath losses in underground cables are low.
15. DC system is suitable for High Power Transmission based on High Current transmission.
16. In DC System, the Value of charging current is quite low, therefore, the length of DC Transmission lines is greater than AC lines.

Disadvantages:

1. Due to commutation problem, electric power can't be produced at high (DC) voltage.
2. For high voltage transmission, we can't step the level of DC voltage (as transformer can't work on DC).
3. There is a limit of DC switches and circuit breakers (and costly too).
4. Motor generator set is used for stepping down the level of DC voltage and the efficiency of motor-generator set is lower than transformer so the system makes complex and costly.
5. The level of DC Voltage can't be changed easily. So we can't get the required voltage for electrical and electronics appliances (such as 5 Volts, 9 Volts 15 Volts, 20 and 22 Volts etc) directly from transmission system.



AC Transmission:

Nowadays, the generation, transmission and distribution are mostly in AC.

Advantages:

1. AC circuit breakers is cheaper than DC circuit breakers.
2. The repairing and maintenance of AC substation is easy and inexpensive than DC substation.
3. The level of AC voltage may be increased or decreased by step up and step down transformers.

Disadvantages:

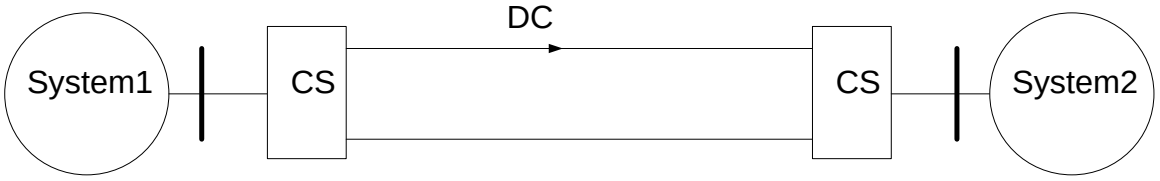
1. In AC line, the size of conductor is greater than DC line.
2. The cost of AC transmission lines is greater than DC transmission lines.
3. Due to skin effect, there are more losses in AC system.
4. In AC lines, there is capacitance, so continuously power loss when there is no load on lines or the line is open.
5. Other line losses are due to inductance.
6. More insulation is required in AC system.
7. Also corona losses occur in AC System.
8. There is telecommunication interference in AC system.
9. There are stability and synchronizing problems in AC system.
10. DC system is more efficient than AC system.
11. There are also re-active power controlling problems in AC system.

The combination of AC and DC electric power transmission

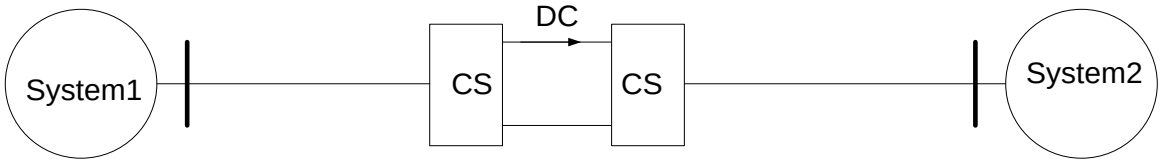
To date, no satisfactory design created switches high voltage DC. Disconnecting the DC line closes the gates of the RS (rectifying substation). Therefore DC transmission has bloc diagram: RS – DCL – IS without the addition of another IS at intermediate points of the line. The technical difficulty of the branched transmission lines caused by DC also features the regime of regulation, to ensure sustainability, the need to contain the accident.

In turn, we can't use the AC line to connect two or more power systems operating in different phases, as this could cause huge equalization currents asynchronous mode. Especially, we can't join systems with varying frequency.

In such situations, the application will be in simultaneous use of AC and DC.



Pic.1. DC transmission.



Pic.2. Inset DC.

In DC power is only used to transport electricity from remote power plants in the receiving system, or from one system to another. For this purpose, an AC electric power generated by the generators of the transmission system must first be converted into DC power, then transmitted by a line, then converted, but in the AC power and transmitted to the receiving system.

When using a direct current inset, at a distance of transportation of energy is carried out using alternating current. Moreover, typically this distance is relatively small, since the liner is used to communicate to each other adjacent systems. Direct current only plays the role of managers, which fully unleashes the connected systems in frequency and, from this point of view, making them independent of each other.

Conclusion

Having two substations (rectifier and inverter) – expensive and complex to operate – hinders widespread use of DC lines. Application of DC electrical energy for transmission can

be an alternative for long-distance AC lines (1500 km and above and the transmission power of 2,000 MW). To a lesser extent DC power is used in solving technical problems of formation of interconnected power systems which cannot be solved by using AC power (ensuring stability of parallel operation, not synchronous communications of power systems, long distance cable lines), as well as in cases where the construction of aircraft and cable lines for AC transmission line is not economically feasible, for example, crossing the sea space. In other cases it is justified to use alternating current electric power for transmission. It is worth noting quite successful practices relating to combined work of both methods.

References:

1. http://www.electricaltechnology.org/2013/05/comparison-between-ac-and-dc.html.
2. http://www.energocon.com/pages/id1320.html.
3. http://lib.rosenergoservis.ru/sovremennaya-elektroenergetika?start=78.
4. http://treugoma.ru/electric-energy/feature-issue/.

Timofeyev, M.A.

Hydro Power Plants

National Research Tomsk Polytechnic University.

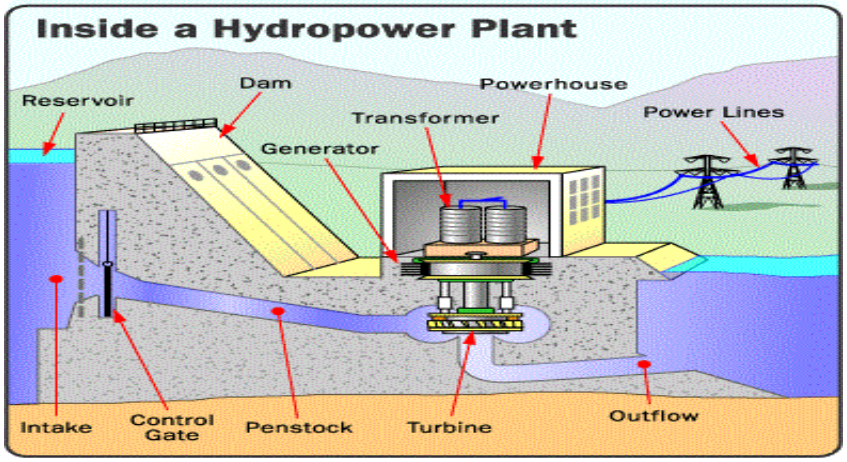
Hydroelectricity is the term referring to electricity generated by hydropower; the production of electrical power through the use of the gravitational force of falling or flowing water. It is the most widely used form of renewable energy, accounting for 16 percent of global electricity generation – 3,427 terawatt-hours of electricity production.

The main aspects of hydro power plants:

1) Design and Operation.
2) Generating methods.
3) Advantages and Disadvantages.

Design and Operation

Operation of HPP 's not much harder than where he worked first station . Thanks circuit hydraulic structures provided the necessary water pressure forces acting on that turbine blades drive a generator . Just today, for HPP does not need to use the Niagara Falls. Hydroelectric their hands can also produce the right amount of energy. Achieve the necessary force head through the construction of a series of dams. Note that in using various types of hydroelectric turbines. The main factor that affects the choice – the power head .All power equipment is located in the power house . In addition to the engine room, which houses all hydraulic units are departments that contain extra equipment, transformer station, device control and management of hydropower etc.



Generating methods

Conventional (dams) – Most hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. The power extracted from the water depends on the vol-